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alcohol until the soap is dissolved. Add now a small quantity of glycerine. The amount of the latter can be readily ascertained by pouring out a few drops of the warm mixture and allowing it to cool. Without any glycerine the mass instantly congeals into a white friable substance quite unfit for our purpose, but as a proportion is gradually added the mass hardens less and less rapidly and becomes more and more transparent. For soft tissues the imbedding mass may be thus made as transparent as glass and exquisite for cutting. For harder substances less glycerine must be used.

With this imbedding material fresh vegetable tissues need no preceding preparation, provided there is not a large amount of water in them, while substances preserved in alcohol are admirably adapted for immediate use. If infiltration is desired it is only necessary to keep the object some time in the warm mass. It is clean, and the instruments remain clean. The transparency enables one to see clearly the position of the object and to manage well the cutting. Thin sections are not so liable to roll up as with most other masses. It is readily soluble in water, but not in cold alcohol. In cutting it is better to keep the razor and the object wetted with the latter and transfer the sections to the former. If a well tube to imbed in is not at hand, pour the melted mass into any convenient dish or paper tray, immerse the object, and when the mass cools, cut it out and shape as required.

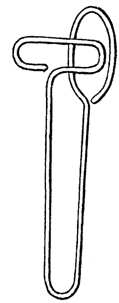
In cutting let the razor rest flat on the glass top of the microtome and *and hold it firmly with both hands.* Make a long draw or push stroke, so that a considerable portion of the edge of the razor is used each cut. See to it that there is not the least vibration of the blade by which the edge may be nicked. If everything is in order, and the handling properly done, it is surprising how hard substances may be cut without this last occurrence. We ought not to be satisfied until we can readily cut sections one-thousandth of an inch thick without tearing or bruising.

GENERAL NOTES.

Starch Grains.—Starch grains in the cells of potato can be beautifully shown by first partially drying the part from which sections are to be made, thereby aiding materially the process of cutting. Remove from a fresh tuber a prism one-fourth to one-half an inch in diameter and an inch or more in length. Expose for a few minutes to moderate heat (hot air from a register is excellent) until the *surfaces* are quite free from moisture, then allow to remain in the ordinary air of the laboratory for twenty-four hours. The consistence

will now be excellent for cutting, and clean cells without ragged remains of ruptured ones may be seen beautifully filled with starch like baskets of fruit. Mount in water. Stain if desired with iodine.—T. J. BURRILL.

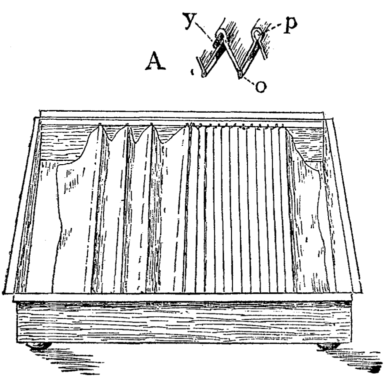
A Spring-Clip.—The accompanying illustration shows a form of spring-clip for microscopical purposes which is at once the cheapest, most easily made and most efficient one with which I am acquainted. It is made of a rather large hairpin, the ends being bent into shape by means of ordinary pliers—preferably round pliers.



A spring-clip.

Quite a wide range of pressure may be readily obtained by bending with the fingers the upper arm to or from the lower.—F. L. SARGENT, *Botanic Garden, Cambridge, Mass.*

A Germinating Pan.—Various methods have been used for testing the per cent. and time of seed germination. Those most commonly adopted in this country and also abroad have been to place the seeds on the surface of porous tile, smooth sand or compacted earth. Without stopping to point out the defects and inconveniences of these methods, I desire to describe an apparatus devised at the N. Y. Agricultural Experiment Station, and which has been found so satisfactory as to supersede all other sorts of germinators at that institution, for general use. It consists of a pan 10 by 14 inches wide, and 3½ inches deep, to be covered with a pane of glass. Along the sides is a ledge ⅜ in. wide, and as much below the upper edge. The pan is best made of tinned copper, the ledge formed by the proper shaping of the sides of the pan, and the edges on three sides turned over to form a groove into which the pane of glass may be slid from one end. These details are not shown in the cut. The seeds are held in the folds of cloth. A strip of white Canton flannel is taken sufficiently wide so that when hemmed on both sides (to prevent seeds slipping out of the ends of the folds) it will be the same as the inside width of the pan. A long enough strip is used to have about twenty-four folds 1½ inches deep, and leave a flap of several inches at each end. The upper margin of the folds is sewn across to permit a ⅛ inch brass rod to be run in from which the cloth is suspended in the pan, as shown in the cut. The lower margins of the folds are also sewn across to make them stay in place better. The total length of the strip after the sewing is completed is about a yard. Two such strips are used in each pan.



Germinating pan with glass top removed: *A*, details of folded cloth; *y*, projecting end of rod which runs through ihe upper seam (*p*) of the folds; *o*, lower seam of the folds.

To put the pan into use, it is filled part full of water, two of the prepared

cloths put in, the glass cover adjusted and the whole boiled over a lamp for a short time. This is necessary in order both to thoroughly wet the cloth and to kill any mold or other germs. When again cool, adjust the cloths on the brass rods, and put in the seeds. Each fold will hold twenty-five large seeds, like beans, and a hundred or more small seeds. Water is placed in the pan, but not enough to touch the folds of cloth; the four flaps drop down into it, however, and keep the cloths sufficiently wet by capillarity, which is increased by the long nap on the under surface of the cloth. The folds are numbered consecutively and the record kept by the numbers.

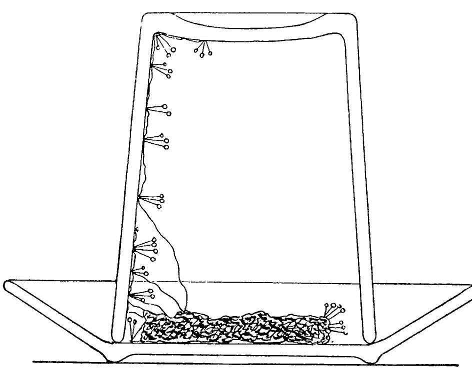
The advantages in a pan of this kind are the facility with which the seeds may be examined and counted, the thorough and uniform moisture of the seeds throughout the longest trials, its lightness and cleanliness. It is necessary to renew the cloths from time to time, as they will slowly rot out, even with the best of care.

This has been recently introduced, I am told, at the U. S. Department of Agriculture, and at one or two other places, under the name of the Geneva germinator.—J. C. A.

A Convenient Laboratory Plant.—One of the plants that has proved most instructive in our laboratory is a *Mucor*, of the Rhizopus section, which springs up spontaneously and can be left growing almost indefinitely on bread.

On freshly cut wheat bread it makes a prompt and rank growth when covered by a tumbler, and illustrates heliotropism very strikingly if grown so as to be strongly shaded on one side and well lighted on the other.

The best cultures for study are usually obtained by inverting tumblers over pieces of rather stale bread, which often fails to show the mold for a number of days (sometimes a week or more). When this appears it usually grows slowly, so that the plants are not crowded. At first the colorless, stolon-like hyphæ spread slowly over the bread, after which they creep off onto the glass, usually reaching a length of a half inch or less, but occasionally becoming two or even three inches long. Where they touch the glass, they attach themselves by short rhizoids and send up tufts of (usually) 2 to 5 pale-brown fruiting hyphæ, each ending in a black sporangium. Where the piece of bread is small, they are scattered over the glass so as to be accessible for observation, without disturbance, several weeks, and at first manifest a slightly developed negative geotropism.


Culture of a Mucor under a tumbler.

Although the bread appears quite dry, it really contains a considerable

quantity of moisture, which, nevertheless, evaporates very slowly. But the mold abstracts much of this and promptly sets it free by transpiration; and when a piece of bread nearly as large as the mouth of the glass is used, the transpired water is so copious that it soon collects on the sides of the glass, appearing first as a faint mistiness, then as drops. Even before the moisture is visible, the plants show a marked sensitiveness to its presence, the tufts of fertile threads standing out at right angles to the damp surface. When the inverted bottom of the tumbler is reached, the same repellent action is evident, the tufts being pendent, while the few which develop in the angle around the bottom bisect it. Now and then a cluster of sporangia comes from the exact edge of the piece of bread, when it makes equal angles with the side and top.

The figure, representing a few of the many cases observed in a single culture, illustrates this negative hydrotropism better than a description. Both heliotropism and hydrotropism are so much stronger than geotropism in this common mold that they are very easily demonstrated to a class by it.

WM. TRELEASE.

Cultivation of Pollen-spores. — In the cultivation of pollen-spores those of monocotyledons are most responsive, and of all that have been tried those of Tradescantia are the most serviceable. The pollen tube begins to develop in a very few minutes, and within an hour becomes many times longer than the spores and has received the spore contents. An ordinary moist chamber is used, constructed of blotting-paper or card-board, as suggested by Bower and Vines in their Practical Botany, p. 16, and by Goodale in his Physiological Botany, p. 430. The points which experience with this special plant suggests are:

1. The culture drop, for a quick response, should be a saturated solution of cane sugar.
2. The spores should be first placed upon the cover glass, and then the culture drop added. If the spores are sown on the culture drop they will remain too far removed from the objective, and the tubes will mostly grow towards the objective and so be seen in optical section instead of in profile.
3. Spores should be obtained from flowers that have been open for some time.

Tradescantia is so common, the moist chambers are so simple, and the response so immediate, that it would seem a pity for any student to fail seeing the extine ruptured and the intine developing into a pollen tube.—J. M. C.

A Cheap Dissecting Microscope.—No laboratory or workers need be unsupplied with dissecting microscopes. If even the cheapest form manufactured by the opticians is beyond the means of the school or individual, an effective stand may be made as follows: Into any block of wood of suitable size fix upright a short piece of stiff wire or rod having a smooth surface. Bore a hole in a fine-grained cork, a little to one side of the center, so that the cork will slide smoothly on the rod. Bend one end of the smaller wire into suitable shape to hold whatever lens is at hand, and make a hole of proper size in the cork at right-angles to the first. This arrangement gives ample and smooth movements of the lens in any direction for adjustment. The plan may be elaborated to any desired extent. If the rod be fixed in a plain piece of board, dissecting may be done on a piece of glass laid flat on the board. Pieces of black or white paper underneath will give the backgrounds against which any object may be seen. For dissecting in liquid a deep individual butter plate answers well. If one desires some transmitted light the object may be dissected on the bottom of an inverted tumbler which has a *smooth* concavity. Sloping blocks may be placed at the sides for hand-rests. Still better illumination may be had by fixing two such blocks, one on each side of the upright rod, and placing between them a strip of mirror glass inclined at an angle of 30°–45°. In fact,

with a little ingenuity and mechanical skill, one may construct a stand for dissecting which will equal in efficiency any of the simple microscopes offered for sale. Of course the lenses must be bought. They may cost any sum the purchaser chooses, from 25c. to $10. The most convenient powers are an *inch* and a *half-inch*, magnifying respectively 10 and 20 diameters. If one already has objectives for compound microscope nothing better can be got.—C. R. B.

A Method of Spore Germination.—In view of the difficulty experienced in growing the spores of those Pteridophytes whose prothallia are destitute of chlorophyll, the following experiments, though incomplete, may perhaps be of service for further investigations:

The spores were sown upon the surface of fine earth, in shallow earthen saucers, and covered with small frames constructed as follows: A shallow box, or rather frame, about four inches across, was made from four narrow strips of wood, the bottom being constructed of fine wire gauze, thus forming a sort of small sieve. This was filled with fine earth pressed firmly down so as to allow as little air as possible to get in between the bottom of the box and the surface upon which the spores were sown. The spores were thus practically under ground and yet could be readily examined by simply lifting the frame. By this process a number of spores of *Botrychium ternatum* were made to germinate, and small prothallia were obtained. In this case germination did not occur until nine months after sowing the spores.

The construction of the frames used was due to a suggestion of my brother, Edward D. Campbell, on my explaining that I wished to contrive some means of easily getting at spores that were to be sown under ground.—DOUGLAS H. CAMPBELL, *Detroit, Mich.*

Fungus Spores.—Fungus spores, as a rule, germinate best when sown *upon* a drop of water in which there is dissolved a small proportion of gum. If the aqueous drop is put on a slide, the spores dusted on the slightly viscid fluid and the whole kept in a moist chamber for twenty-four hours, at the ordinary temperature of the laboratory, an examination will often be rewarded by an instructive exhibition of germinal tubes. The same may be said of pollen grains, though the addition of a little nectar or sugar to the fluid, in this case, is useful.—T. J. BURRILL.

Potassic Hydrate Bottle.—In a laboratory where a considerable quantity of potassic hydrate is uesd, a bottle furnished with a siphon (kept always filled, closed by a pinch-cock near the lower end), and a U-tube will be found convenient. The U-tube should be sealed with potassic hydrate so that the air which enters the bottle, as its contents is used, may bubble through this liquid in the tube and thus be deprived of the carbonic dioxide which would otherwise cause a precipitate in the bottle. By such an arrangement one may always have clean potassic hydrate in any quantity without annoyance from the pellicle of potassic carbonate, sure to be formed in open bottles, the sticking of glass stoppers, or the dissolution of cork ones.—C. R. B.

Streaming of Protoplasm—The streaming motion of protoplasm can be exhibited very satisfactorily in the thin membrane (upper epidermis of scale-leaf) found between the scales of the bulb of the common onion. All that is necessary to do is to transfer a piece of the fresh membrane, snipped off by a pair of scissors, to a drop of water on a slide, cover and examine with a power of four hundred or so times. The temperature of a comfortable room is about right, with less heat the movement is very slow. Success is more certain if the bulb has started to grow, as they often do in a cellar.

Care should be taken in removing the membrane, for the cell walls are very delicate and easily wrinkle, forming unsightly and annoying, irregular lines over what should be the clear open cell.

The material commends itself for its accessibility at any time, and espe-

cially in winter when other things may not be readily obtained, and for the extreme ease of preparation.—T. J. BURRILL.

Laboratory Articles in Back Numbers.—This journal has already published considerable, during its ten years of existence, in reference to laboratories. To make this scattered information more readily serviceable, we herewith give references to the more important articles and items:

Teaching and means of illustration.—Methods of teaching, VI, 233, 302; Making of charts, VI, 186.

Instruments and material.—Convenient dissecting microscope, III, 37; Compound microscopes for botanical work, VI, 193; Apparatus for measuring growth, VI, 172; Stopper for bacteria culture vessels, X, 308; Material for laboratory use, IV, 196, V, 133, VI, 244, 294, VII, 10, 35, 125.

Manipulation.—Section cutting, V, 28, VI, 194; Mounting, V, 27, VI, 194; Staining, IV, 201, V, 65; Cleaning cover-glasses, V, 30.

Physiological demonstrations.—Direct observation of the movement of water in plants, VIII, 260; Study of ovules and germinating pollen grains, X, 353; Growing fern prothallia, X, 356; Cultivation of spores, VI, 204; Cultivation of bacteria, X, 391; Demonstration of continuity of protoplasm, VIII, 323, X, 322.

Herbarium work.—Applying pressure in making botanical specimens, I, 21; Pressing to preserve color, VI, 256; Cement for herbarium, IV, 215, IX, 62; Carbon bisulphide for preserving plants, II, 101.

EDITORIAL NOTES.

THE NEW botanical laboratory at the University of Strassburg cost $130,000.

HOGG'S standard work on the microscope has reached its eleventh edition.

EDMOND BOISSIER, a well known botanist, died September 25, at Valleyres, Switzerland, at 76 years of age.

DR. GRAY WRITES: *Coreopsis delphinifolia* has been lost from the Botanic Garden at Cambridge. Who can generously supply it anew, from roots or seeds?

BACTERIOLOGY receives the chief attention of the new Institute of Hygiene recently founded in connection with Berlin University, and presided over by Dr. Koch.

IT MAY BE interesting to know that the contributors to the Gray vase represent several provinces of British America and thirty-three States and Territories of the Union.

OUR JANUARY NUMBER will contain a portrait and biographical sketch of Dr. Asa Gray, together with a few of the congratulatory addresses and poems sent to him on his last birthday.

THE SHAW SCHOOL OF BOTANY was opened November 6, with a public lecture by Dr. Trelease, to be followed by a course of four lectures on fertilization of flowers. The laboratory work began promptly with fifteen students, who took up the study of grasses.

THE NEW LABORATORY for the investigation of plant diseases in the Agricultural Department at Washington, makes slow progress toward securing an outfit, owing to lack of funds. It is hoped that Congress will make early provision for this need at its present session.

WE HAVE MADE arrangements by which any who desire can obtain excellent cabinet photographs of both sides of the Gray vase, which, of course, far sur-